

**U.S. FISH AND WILDLIFE SERVICE  
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Vetericaris chaceorum*

COMMON NAME: Anchialine pool shrimp

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: April 2010

**STATUS/ACTION**

☐ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status

☐ New candidate

☒ Continuing candidate

☐ Non-petitioned

☒ Petitioned - Date petition received: May 11, 2004

☐ 90-day positive - FR date:

☒ 12-month warranted but precluded - FR date: May 11, 2005

☐ No Did the petition request a reclassification of a listed species?

**FOR PETITIONED CANDIDATE SPECIES:**

a. Is listing warranted (if yes, see summary of threats below)? Yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? Yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded.

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for the species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The "Progress on Revising the Lists" section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

☒ Listing priority change

Former LP: \_\_\_\_

New LP: \_\_\_\_

Date when the species first became a Candidate (as currently defined): October 25, 1999

☐ Candidate removal: Former LPN: \_\_\_\_

- \_\_\_ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
- \_\_\_ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
- \_\_\_ F – Range is no longer a U.S. territory.
- \_\_\_ I – Insufficient information exists on biological vulnerability and threats to support listing.
- \_\_\_ M – Taxon mistakenly included in past notice of review.
- \_\_\_ N – Taxon does not meet the Act’s definition of “species.”
- \_\_\_ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Crustaceans; Family Procarididae (anchialine pool shrimp)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Hawaii

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Hawaii

LAND OWNERSHIP: The single anchialine pool where this species occurs is wholly owned by the State of Hawaii and is administered by the State of Hawaii Department of Hawaiian Home Lands (DHHL).

LEAD REGION CONTACT: Linda Belluomini, (503) 231-6283, linda\_belluomini@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish & Wildlife Office, Christa Russell (808) 792-9400, christa\_russell@fws.gov

## BIOLOGICAL INFORMATION

### Species Description

*Vetericaris chaceorum* has a total length of approximately 2 inches (5.0 centimeters), not including the primary antennae which are approximately the same length as the shrimp’s total length. Based on a number of morphological characters, this genus is considered primitive (Kensley and Williams 1986, pp. 419-427). In limited observations, *V. chaceorum* was observed to swim in midwater, never being stationary on the substrate. The shrimp uses its primary thoracic appendages (pereopodal exopods) as well as its abdominal appendages (pleopods) for propulsion in a forward direction (Kensley and Williams 1986, pp. 419-427). Use of tail-beats for backward propulsion was never observed. Large chelapeds (claws) are lacking. While gut contents included fragments of other crustaceans (including *Procaris hawaiiiana* another

candidate species), no feeding has been observed, and it is not known if this species is a predator, scavenger, or both (Kensley and Williams 1986, pp. 419-427).

### Taxonomy

We have reviewed the taxonomic background of *Vetericaris chaceorum* and find it to be a valid taxon. *Vetericaris chaceorum* is a monotypic genus that was originally described by Kensley and Williams in 1986. The US Department of Agriculture's Integrated Taxonomic Information Systems 2007 online database considers the taxonomy of this species to be valid, and this species is recognized as a valid taxon in MacLauglin *et al.* (2005).

### Habitat/Life History

Anchialine pools are land-locked bodies of water that occur coastally but are not openly connected to the ocean (Maciolek 1983, pp. 607-612). They are mixohaline, with salinities ranging from 2 parts per thousand (ppt) to concentrations just below that of sea water (32 ppt) (Brock *et al.* 1987, p. 200). Anchialine pools are typically subject to tidal fluctuations. Except for some records of endemic eels, anchialine pools do not generally support native species of fish although some species of nonnative fish have been introduced and are currently recognized as problems (Bailey-Brock and Brock 1993, p. 354).

At Lua O Palahemo on the island of Hawaii, *Vetericaris chaceorum* co-occurs with other species of native shrimp including *Palaemon debilis*, *Callinectes pholidota*, *Procaris hawaiiensis* (a candidate species), and *Antecaridina lauensis* (Holthuis 1973, pp. 12-19; Maciolek 1983, pp. 606-613). Unlike most anchialine pools in Hawaii, which are no more than a few meters in depth, Lua O Palahemo is a lava tube which reaches a depth of nearly 131 feet (ft) (40 meters (m)) and extends for a submerged, subterranean length of nearly 984 ft (300 m) (Kensley and Williams 1986, pp. 417-419). Salinities within this single pool range from 20 ppt at the surface to 30 ppt at its deepest, most seaward location. Dissolved oxygen was recorded to range from 6.0 parts per million (ppm) at the surface to 0.3 ppm at the deepest sample station (Kensley and Williams 1986, pp. 417-419).

### Historical Range/Distribution

Although anchialine pools are widespread, being found in areas such as Saudi Arabia, Madagascar, Fiji, and other Indo-Pacific islands, the total area occupied by them globally is extremely small (Maciolek 1983, p. 607). While a number of species of anchialine shrimp (e.g., *Antecaridina lauensis*, *Callinectes pholidota*) have disjunct, global distributions within these habitats, most geographic locations contain some endemic taxa (Maciolek 1983, p. 607). *Vetericaris chaceorum* is one of these endemic taxa that have only been reported from a single location, Lua O Palahemo, on the island of Hawaii (Hawaii Biodiversity and Mapping Program (HBMP) 2006a).

### Current Range/Distribution

*Vetericaris chaceorum* is still only known from the one occurrence site at the lava tube, Lua O Palahemo, on the island of Hawaii. Surveys conducted of other anchialine pools in Hawaii, including other pools on the island of Hawaii, Oahu, and Maui, have not found this species.

### Population Estimates/Status

As well as being very restricted in range, relatively few individuals were encountered in the last survey (1985) for this species by Kensley and Williams (1986). There were only five detections of *Vetericaris chaceorum* during three separate dives (Kensley and Williams 1986, pp. 419-429).

A site visit by U.S. Fish and Wildlife Service (Service) employees to view and note surface conditions was conducted in 2005. There are no records of any population surveys for this species since 1986. Like other anchialine pool shrimp species, it is believed that this species inhabits an extensive network of water-filled interstitial spaces (cracks and crevices) leading to and from the actual pool (the Lua O Palahemo lava tube system), and this trait has precluded researchers from obtaining more accurate population size estimates.

### THREATS

#### A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Development of coastline areas has been responsible for the destruction or degradation of anchialine pools on all of the Hawaiian Islands (Bailey-Brock and Brock 1993, p. 354). Brock (2004) estimates that up to 90 percent of the pools on the island of Hawaii may have been destroyed by such activities or by the introduction of nonnative fish into anchialine pools (see “C” below). Lua O Palahemo now lies within lands administered by the State of Hawaii’s DHHL. It is still accessible by the public. Currently, there are no known plans for future use of these lands. Brock (2004, pp. 13-17) identified the use of anchialine pools as refuse receptacles as an example of habitat degradation. Brock (2004) also stated that refuse, like bottles and cans, appears not to have any short-term negative impact but the dumping of used oil, grease and oil filters have resulted in the disappearance of another species of anchialine pool shrimp, *Halaocaridina rubra* from a pool adjacent to Honokohau Harbor on the island of Hawaii. During the 2005 site visit by Service employees, there was no evidence of dumping, though in previous years dumping was reported (Brock 2004, pp. 13-17).

#### B. Overutilization for commercial, recreational, scientific, or educational purposes.

*Vetericaris chaceorum* has been collected, on a very small scale, for scientific/educational purposes on only a few occasions (Kensley and Williams 1986, pp. 419-429). While there is no record of collection of this species for commercial or recreational purposes, the Service has become aware of companies and private collectors using anchialine pool shrimp and related shrimp species for self-contained aquariums similar to those marketed by Ecosphere Associates, Inc. (Ecosphere Associates 2006, p. 1). One company located in Hawaii, FukuBonsai, has already begun using Hawaiian anchialine pool species for the aquarium hobby market (FukuBonsai 2007, p. 1). For commercial purposes, currently only a State Commercial Marine License is required to collect anchialine pool shrimp. The Service believes this particular species is not likely to be among those species collected for trade and business due to the difficulty in collecting it. Unlike the other Hawaiian anchialine pool shrimp species, collecting *V. chaceorum* may require involved dives with the use of scuba equipment. Access to the pool by aquarium collectors is not controlled or limited by DHHL.

#### C. Disease or predation.

In Hawaii, predation by introduced nonnative fish is considered to be the greatest threat to

native shrimp within anchialine pool ecosystems (Bailey-Brock and Brock 1993, p. 354; Brock 2004, pp. 13-17). Anchialine pools have been used to discard or hold bait-fish and/or aquarium fish (Bailey-Brock and Brock 1993, p. 354). These fish either directly consume the native shrimp or, as with introduced tilapia (*Oreochromis mossambica*), out-compete the native herbivorous species of shrimp that typically serve as the prey-base for the rarer, predatory species of shrimp. Introduction of nonnative fish including bait-fish into such pools may have been a major contributor to the decline of these shrimp.

At Lua O Palahemo a sign stating “Lua O Palahemo Site disturbance subject to fine HRS 6E and 16 USC 3701” has been placed at the single pool. However, this may not be an adequate deterrent. For example, since 1985 signage was used in an attempt to keep people from entering the Waikoloa Achialine Pond Preserve at Waikoloa, North Kona, Hawaii. Visitors were not allowed into the pool preserve but could walk around the perimeter. In December of 2003, it was discovered that someone had released tilapia and mosquito fish into the system. Within six months time, two thirds of the system had been invaded by the alien fish and all the anchialine pool shrimp disappeared (Brock 2004, pp. 13-17). Although during the 2005 site visit by Service employees there was no evidence of nonnative fish in the pool, the threat of invasion of nonnative fish into Lua O Palahemo where *Vetericaris chaceorum* occurs is great since the pool is easily accessible to the public.

D. The inadequacy of existing regulatory mechanisms.

This species is not protected under Hawaii's endangered species law (HRS, Sect. 195-D) or the Federal Endangered Species Act (16 U.S.C. §1531-1544) and there are no existing regulatory mechanisms that specifically protect this species other than the requirement that individuals possess a State Commercial Marine License prior to its collection from the wild.

E. Other natural or manmade factors affecting its continued existence.

Even if the threats responsible for the decline of this species were controlled, the persistence of its one existing population is hampered by the small geographic range of the known population. This circumstance makes the species more vulnerable to extinction due to a variety of natural processes. Small or single populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988; Center for Conservation Biology 1994). Small or single populations are also demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio (Lande 1988).

## CONSERVATION MEASURES PLANNED OR IMPLEMENTED

A single sign has been posted at the site stating that disturbing the site is subject to a fine.

Due to State of Hawaii budget shortfalls, our joint efforts with the State Division of Aquatic Resources to develop a statewide monitoring plan for anchialine pool shrimp, including *Vetericaris chaceorum*, has also been put on hold. We have purchased an underwater video camera and plan to resurvey the lava tube during the summer or fall of 2010.

On June 16, 2008, a symposium on anchialine pool conservation and management was held at the 89<sup>th</sup> annual meeting of the American Association for the Advancement of Science, Pacific Division. In addition, a statewide meeting concerning the monitoring of anchialine pools was hosted by the Service on January 15, 2009. Results of that meeting include an update on the status of monitoring efforts across the State, initiation of the development of a common monitoring protocol, and the establishment of a listserv.

SUMMARY OF THREATS (including reasons for addition to or removal from candidacy, if appropriate):

Based on our evaluation of habitat degradation and loss due to illegal trash dumping in anchialine pools and the effects of predation by nonnative fish we conclude there is sufficient information to develop a proposed rule for this species due to the threat of habitat destruction or contamination by dumping, and the threat of the release of nonnative fish in the only known pool habitat of *Vetericaris chaceorum*. In addition, overcollection by the aquarium hobby market is a potential threat to *V. chaceorum*. We find that this species is warranted for listing throughout all its range, and, therefore, find that it is unnecessary to analyze whether it is threatened or endangered in a significant portion of its range.

For species that are being removed from candidate status:

\_\_\_ Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

#### RECOMMENDED CONSERVATION MEASURES:

- Conduct quarterly day and evening surveys of the lava tube.
- Monitor the site on a quarterly basis for evidence of trash dumping, presence of nonnative fish, and other habitat changes.
- Post informational signs asking people not to use the pool as a refuse for human waste and other trash or as a place to release fish.
- Conduct ecological research on habitat requirements and basic life history of *Vetericaris chaceorum*

## LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
<b>High</b>	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	<b>Non-imminent</b>	<b>Monotypic genus</b>	<b>4*</b>
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

### *Magnitude:*

The threats to *Vetericaris chaceorum* from habitat degradation and destruction, and predation by nonnative fish are of high magnitude because this species occurs in only one pool. All individuals of this species may be adversely impacted by a single dumping of trash or release of nonnative fish in its only known pool.

### *Immediacy of Threats:*

The primary threats to this species from trash dumping and nonnative fish are non-imminent because there were no signs of major dumping or fill, or nonnative fish in the pool on a site visit in early 2005.

Rationale for Change in Listing Priority Number (insert if appropriate)

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

### Is Emergency Listing Warranted?

No. The species does not appear to be appropriate for emergency listing at this time because nonnative fish do not occur in the pool and there were no signs of dumping or fill on the most recent site visit (2005). It is believed the primary habitat these shrimp inhabit are tiny (inaccessible to humans and most fish) cracks and crevices within the lava rock. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in

this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *Vetericaris chaceorum* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

#### DESCRIPTION OF MONITORING

We conducted literature searches for recent articles on this species and contacted relevant species experts. The State officials with the Department of Land and Natural Resources, University of Hawaii, and Auburn University researchers were contacted regarding the current status of this species. No additional information on the species' status was found over the past year.

This level of monitoring is appropriate to update the status of the species because a thorough literature search was conducted as well as relevant species experts contacted. Information contained in this assessment form was verified by species experts.

#### List of Experts Contacted:

Name	Date	Affiliation
Thomas Iwai	February 19, 2010	Division of Aquatic Resources (Retired)
Michael Yamamoto	February 19, 2010	Division of Aquatic Resources (Retired)
Annette Tagawa	February 19, 2010	Division of Aquatic Resources
Troy Sakihara	February 19, 2010	Division of Aquatic Resources
Dan Polhemus	February 19, 2010	Division of Aquatic Resources
Robert Nishimoto	February 19, 2010	Division of Aquatic Resources
Richard Brock	February 19, 2010	University of Hawaii
Scott Santos	February 19, 2010	Auburn University
David Foote	February 19, 2010	USGS
Sallie Beavers	February 19, 2010	National Park Service
Tahzay Jones	February 19, 2010	National Park Service
Matt Ramsey	February 19, 2010	Division of Forestry and Wildlife

The Hawaii Biodiversity and Mapping Program (HBMP) lists this species as critically imperiled (HBMP 2006b). This species is not listed in the International Union for Conservation of Nature and Natural Resources (IUCN) Red Data List database (IUCN database 2006). *Vetericaris chaceorum* is included in the list of species in Hawaii's 2005 Comprehensive Wildlife Conservation Strategy. In addition, in March 2007, the State of Hawaii initiated a separate strategic plan focusing exclusively on invertebrates. It is expected that *V. chaceorum* will be one of the species covered by the new plan (Mitchell *et al.* 2005).

## COORDINATION WITH STATES

On February 11, 2010, we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. No response was received. In addition, we contacted the Hawaii DAR on February 19, 2010. No new information on the status of this species was available.

## LITERATURE CITED

- Bailey-Brock, J.H. and R.E. Brock. 1993. Feeding, reproduction, and sense organs of the Hawaiian anchialine shrimp *Halocaridina rubra* (Atyidae). *Pacific Science* 47:338-355.
- Brock, R.E. 2004. Anchialine Resources in Two Hawaii State Natural Area Reserves: Ahihi Kinau, Maui Island and Manuka, Hawaii Island with Recommendations for Their Management. Prepared for the U.S. Fish and Wildlife Service by Environmental Assessment, LLC.
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- Lande, R. 1988. Demographic models of the northern spotted owl (*Strix occidentalis caurina*). *Oecologia* 75: 601-607.
- Maciolek, J.A. 1983. Distribution and biology of Indo-pacific insular hypogean shrimps. *Bulletin of Marine Science* 33:606-618.

McLaughlin, P.A., D.K. Camp, M.V. Angel. 2005. Common and scientific names of aquatic invertebrates from the United States and Canada: Crustaceans. American Fisheries Society Special Publication 31. Bethesda MD, USA. 545pp.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. *Hawaii's Comprehensive Wildlife Conservation Strategy*. Department of Land and Natural Resources. Honolulu, Hawaii. 722 pp.

US Department of Agriculture. Integrated Taxonomic Information Systems 2006. Taxonomic Database. <http://www.itis.gov>. Downloaded on 05 February 2007.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:

Acting Carolyn L. Bohan 5/18/10  
Regional Director, Region 1, Fish and Wildlife Service Date

Ronan W. Gould  
ACTING  
Director, Fish and Wildlife Service October 22, 2010

Concur:

Do not concur: \_\_\_\_\_  
Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review: April 14, 2010  
Conducted by: Lorena Wada, Pacific Islands FWO  
Biologist, Prelisting and Listing Program

Comments:  
PIFWO Review

Reviewed by: Christa Russell Date: April 19, 2010  
Prelisting and Listing Program Coordinator

Marilet Zablan Date: April 26, 2010  
Assistant Field Supervisor, Endangered Species Division

Gina Shultz Date: April 30, 2010  
Acting Field Supervisor